

B.Tech IV-I Semester (ME)

S. No.	Course Code	Subject	L	T	P	C
1.	15A52601	Management Science	3	1	-	3
2.	15A03701	Automobile Engineering	3	1	-	3
3.	15A03702	CAD/CAM	3	1	-	3
4.	15A03703	Metrology and Measurements	3	1	-	3
5.	15A03704 15A03705 15A03706	CBCC-II a. Refrigeration and Air – Conditioning b. Tool Design c. Modern Manufacturing Methods	3	1	-	3
6.	15A03707 15A03708 15A03709	CBCC-III a. Computational Fluid Dynamics b. Automation and Robotics c. Production & Operations Management	3	1	-	3
7.	15A03710	CAD/ CAM Laboratory	-	-	4	2
8.	15A03711	Metrology and Measurements Laboratory	-	-	4	2
Total:			18	6	8	22

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15A52601 MANAGEMENT SCIENCE

Course Objective: The objective of the course is to equip the student the fundamental knowledge of management science and its application for effective management of human resource, materials and operation of an organization. It also aims to expose the students about the latest and contemporary developments in the field of management.

UNIT –I

Introduction to Management: Concept-Nature and Importance of Management, Functions-Evaluation of Scientific Management, Modern management-Motivation Theories-Leadership Styles-Decision Making Process-Designing Organization Structure-Principles and Types of Organization.

UNIT- II

Operations Management: Plant location and Layout, Methods of production, Work-Study-Statistical Quality Control through Control Charts, Objectives of Inventory Management, Need for Inventory Control-EOQ&ABC Analysis(Simple Problems)**Marketing Management:** Meaning,Nature, Functions of Marketing, Marketing Mix, Channels of distribution- Advertisement and sales promotion-Marketing strategies-Product Life Cycle.

UNIT –III

Human Resource Management(HRM): Significant and Basic functions of HRM- Human Resource Planning(HRP), Job evaluation, Recruitment and Selection, Placement and Induction-Wage and Salary administration. Employee Training and development-Methods-Performance Appraisal-Employee Grievances-techniques of handling Grievances.

UNIT –IV

Strategic Management: Vision, Mission, Goals and Strategy- Corporate Planning Process-Environmental Scanning-SWOT analysis-Different Steps in Strateg Formulation, Implementation and Evaluation. **Project Management:** Network Analysis- PERT, CPM, Identifying Critical Path-Probability-Project Cost Analysis, Project Crashing (Simple Problems).

UNIT-V

Contemporary Management Practices: Basic concepts of MIS-Materials Requirement Planning(MRP),Just-In-Time(JIT)System, Total Quality Management(TQM)-Six Sigma

and Capability Maturity Models(CMM) evies, Supply Chain Management, Enterprise Resource Planning(ERP),Performance Management, Business Process Outsourcing(BPO), Business Process Re-Engineering and Bench Marking, Balance Score Card.

Learning Outcome: This course enables the student to know the principles and applications of management knowledge and exposure to the latest developments in the field. This helps to take effective and efficient management decisions on physical and human resources of an organization. Beside the knowledge of Management Science facilitates for his/her personal and professional development.

TEXT BOOKS:

1. A.R Aryasri: Management Science, TMH, 2013
2. Kumar /Rao/Chalill 'Introduction to Management Science' Cengage, Delhi, 2012.

REFERENCE BOOKS:

1. A.K.Gupta "Engineering Management",S.CHAND, New Delhi, 2016.
2. Stoner, Freeman, Gilbert, Management, Pearson Education,New Delhi, 2012.
3. Kotler Philip & Keller Kevin Lane: Marketing Mangement , PHI,2013.
5. Koontz & Weihrich: Essentials of Management, 6/e, TMH, 2005.
6. Kanishka Bedi, Production and Operations Management, Oxford University Press, 2004.
7. Memoria & S.V.Gauker, Personnel Management, Himalaya, 25/e, 2005
8. Parnell: Strategic Management, Biztantra, 2003.
9. L.S.Srinath: PERT/CPM,Affiliated East-West Press, 2005.

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15A03701 AUTOMOBILE ENGINEERING

Course Objective:

The students acquires sufficient knowledge to classify Engines, Chassis, Fuel Supply Systems, Cooling Methods, Lubrication Methods, Ignition Systems, Generating Systems, Suspension Systems, transmission system, steering mechanism and braking methods.

The students get the working knowledge of assembly of various components of layout and of various electrical equipment of an automobile.

UNIT I

Introduction: Components of a Four Wheeler Automobile – Chassis and Body – Power Unit –Power Transmission – Rear Wheel Drive, Front Wheel Drive, Four Wheel Drive – Types of Automobile Engines, Engine Construction, Turbo Charging and Super Charging – Oil Filters, Oil Pumps – Crank Case Ventilation.

Learning outcome & Suggested Student Activities:

Student can understand the function of each and every component of an automobile. Student can understand the use of turbo charging and super charging. Students may refer the following website auto.howstuffworks.com, www.em.gov.au for better understanding of this topic.

UNIT II

Transmission System: Clutches- Principle- Types: Cone Clutch, Single Plate Clutch, Multi Plate Clutch, Magnetic and Centrifugal Clutches, Fluid Fly Wheel – Gear Box-Types: Sliding Mesh, Constant Mesh, Synchromesh, Epi-Cyclic, Over Drive, Torque Converter.

Propeller Shaft – Hotch – Kiss Drive, Torque Tube Drive, Universal Joint, Differential, Rear Axles.

Learning outcome & Suggested Activities:

Student can be able to grasp the knowledge on emission standards, emission control techniques and electrical systems. Student can identify thrust areas for carrying their dissertation in future. Students may refer the following website www.dec.ny.gov, www.studymode.com, www.ehow.com, www.automotiveservices.blogspot.com for better understanding of this topic.

UNIT III

Steering System: Steering Geometry – Camber, Castor, King Pin Rake, Combined Angle Toe-In, Center Point Steering. Types Of Steering Mechanism – Ackerman Steering Mechanism, Davis Steering Mechanism, Steering Gears – Types, Steering Linkages.

Learning outcome & Suggested Student Activities:

At the end of the unit, student can have broad knowledge on each and every component of transmission system of a automobile. Students may refer the following websites en-wikipedia.org/wiki/transmission, www.youtube.com, www.youtube.com, jalopink.com, www.geansandstuff.com for better understanding of this topic.

UNIT IV

Suspension System: Objects of Suspension Systems – Rigid Axle Suspension System, Torsion Bar, Shock Absorber, Independent Suspension System.
Braking System: Mechanical Brake System, Hydraulic Brake System, Pneumatic and Vacuum Brake Systems.

Learning outcome & Suggested Student Activities:

After the completion of the chapter, student can able to understand purpose and methods of steering systems and their applications. Students may refer the following website www.scribd.com, www.youtube.com, leemyles.com www.howcanworks.com, www.forza.se/sider/of/listton/bi/stein1.pdf for better understanding of this topic.

UNIT V

Emissions from Automobiles – Pollution Standards National and International – Pollution Control– Techniques – Multipoint Fuel Injection for SI Engines- Common Rail Diesel Injection, Emissions from Alternative Energy Sources– Hydrogen, Biomass, Alcohols, LPG, CNG - Their Merits And Demerits.
Electrical System: Charging Circuit, Generator, Current – Voltage Regulator – Starting System, Bendix Drive, Mechanism of Solenoid Switch, Lighting Systems, Horn, Wiper, Fuel Gauge – Oil Pressure Gauge, Engine Temperature Indicator.

Learning outcome & Suggested Student Activities:

At the end of the unit. Student can have ample knowledge on suspension system and braking system of an automobile. Students may refer the following website www.youtube.com, www.howcanworks.com, www.forza.se/sider/of/listton/bi/stein1.pdf for better understanding of this topic.

Text Books:

1. *Automotive Mechanics – Vol. 1 & Vol. 2*, Kirpal Singh, Standard Publishers Distributors, 13th edition, 2013.
2. *Automobile Engineering*, William Crouse, TMH, 10th edition, 2006.

Reference Books:

1. *Automobile Engineering*, R.K.Rajput, Laxmi Pub, 1st edition, 2013.
2. *Automobile Engineering*, K.K.Ramalingam/Scitech Pub, 2nd edition.
3. *Automotive engines*, Newton, Steeds & Garret.

Books in Digital Libraray:

www.nptel.iitm.ac.in

Suggestions:

Student is requested to visit the research and development cell of Automobile manufacturing companies and A.R.A.I emission testing centers.

For better understanding of these systems students may visit the Automobile service centre and APSRTC workshop.

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15A03702 CAD/CAM

Course objective:

The objective of the this subject is to enable the students to understand and handle design problems in symmetric manner, gain practical experience in handling 2-D drafting and 3-D modeling software systems, apply CAD in real life applications, understand the concepts G and M codes and manual part programming and know the applications of CNC machines. Further the students will become familiar on principles of computer graphics, geometric modeling, NC and CNC machines, group technology and FMS.

UNIT I

Overview of CAD/CAM: Product cycle, CAD, CAM and CIM. CAD Tools, CAM Tools, Utilization in an Industrial Environment, Evaluation criteria. CAD standards, CAD data structure, Data base management systems.

Computer Graphics: Co-ordinate systems, Graphics package functions, 2D and 3D transformations, homogeneous transformations, clipping, hidden line / surface removal colour, shading.

Learning outcome & Suggested Student Activities:

After completion of this unit students are able to understand the basic concepts Automation, components of CAD/CAM, input and output components of CAD, Steps involved in computer aided design.

UNIT II

Geometric Modeling: Representation techniques, Parametric and non parametric representation, various construction methods, wire frame modeling, synthetic curves and their representations, surface modeling, synthetics surfaces and their representations.

Solid modeling, solid representation, fundamentals, introduction to boundary representations, constructive solid geometry, analytical solid modeling.

Learning outcome & Suggested Student Activities:

After completion of this unit students are able to understand the geometric model of the component in CAD technology of computer graphics. The techniques of raster technology, scan conversion, clipping, removal of hidden lines and hidden surfaces, color, shading and texture.

UNIT III

Numerical Control: NC, NC Modes, NC Elements, NC Machine tools and their structure, Machining centre, types and features. Controls in NC, CNC systems, DNC systems. Adaptive control machining systems, types of adaptive control.

CNC Part Programming: Fundamentals, NC word, NC Codes, canned cycles, cutter radius compensation, length compensation, computed assisted part programming using APT: Geometry statements, motion statements, post process statements, auxiliary statements, macro statement program for simple components.

Learning outcomes & Suggested Student Activities:

Geometric Modelling constitutes the most important and complex part in most of CDA software packages. Hence the students should focus on various requirements of information that are generated during geometric modeling stage, various types and its applications. Mathematical representations of curves used in geometric construction.

UNIT IV

Group Technology & FMS: Part Family, Classification and Coding, advantages & limitations, Group technology machine cells, benefits. FMS: Introduction, components of FMS, material handling systems, Computer control systems, advantages.

Computer Aided Quality Control: Terminology in Quality control, Inspection and testing, Contact inspection methods - optical and non optical, integration of CAQC with CAD and CIM

Learning outcome & Suggested Student Activities:

CNC has revolutionized the manufacturing automation. The flexibility of manufacturing achieved with the use of CNC and associated Technology. The students should aimed to understand the principle of NC, CNC, Machining Centre and various methods of part programming. The student is advised to visit manufacturing industry where the CNC machines are using and also interact with CNC programmer in industry.

UNIT V

Computer Aided Processes Planning: Retrieval type and Generative type, benefits, Machinability data systems, Computer generated time standards.

Computer integrated production planning: Capacity planning, shop floor control, MRP-I, MRP-II, CIMS benefits. Trends in Manufacturing systems: Concepts of Reconfigurable manufacturing, Sustainable manufacturing and lean manufacturing.

Learning outcomes & Suggested Student Activities:

Understanding the need of GT as a means of bringing the benefits of mass production to relatively smaller production. Understanding the need of computers in process planning and QC. Understanding the definition and concept of FMS, and its elements etc.

Text Books:

1. CAD/CAM, A Zimmers&P.Groover, PE, PHI
2. CAD/CAM-Principles and applications, P.N. Rao, TMH, 3rd edition, 2010

Reference Books:

1. Computer Aided Design & Manufacturing, Lalit Narayan/Mallikarjuna Rao/M.M.M.Sarcar.PHI(2015)
2. Automation, Production systems & Computer integrated Manufacturing ,Groover, P.E
3. CAD/CAM/CIM, Radhakrishnan and Subramaniah, New Age, 3rd edition, 2008
4. Principles of Computer Aided Design and Manufacturing, FaridAmirouche, Pearson
5. CAD/CAM Theory and Practice, R. Sivasubramaniam, TMH
6. Computer Aided Design and Manufacturing, K.Lalit Narayan , PHI, 2008.
7. Computer Aided Manufacturing, T.C. Chang, Pearson, 3rd edition, 2008
8. A text book of CAD/CAM, CSP Rao, Hitech Publ.

Web References:

- http://www.cadcamfunda.com/cam_computer_aided_manufacturing
<http://wings.buffalo.edu/eng/mae/courses/460-564/Course-Notes/cnc-classnotes.pdf>

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15A03703 METROLOGY AND MEASUREMENTS

Course objective:

Students will be able to understand the Limits and Fits, linear measurements and angular measurements, gauges, comparators, optical measuring methods, measurement of flatness and roughness of surface. And also learn about the screw thread and gear measuring methods, Alignment tests on machine tools.

Students will be able to understand various transducers to measure displacement like Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers and also learn about Calibration procedure, temperature and pressure calibration methods, the measurement of flow stress, strain measurements acceleration and vibration.

UNIT I

LIMITS, FITS and TOLERANCES : Introduction, Definitions, fits and their types – unilateral and bilateral tolerance system, hole and shaft basis systems – interchangeability and selective assembly. Indian standard system – International Standard organization system for plain work.

LIMIT GAUGES and GAUGE DESIGN: Plug, Ring, Snap, Gap, Taper gauges. Taylor's principle. Design of Go and No Go gauges.

COMPARATORS: Principle of Measurement with Mechanical, Optical, Electrical, Electronic, Pneumatic comparators and their uses.

Learning outcome & Suggested Student Activities:

After completion of this unit students are able to understand the Limits, Fits and Tolerance. Indian standard system – International Standard organization system. He will know the principles of working of the most commonly used instruments for measuring linear and angular distances.

<http://www.nptel.iitm.ac.in>

<http://www.learnerstv.com/Free-Engineering-Video-lectures-Itv113-Page1.htm>

UNIT II

LINEAR MEASUREMENT: Length standard, line and end & wavelength standards, slip gauges – calibration of the slip gauges, Dial indicator, micrometers, vernier height gauges.

MEASUREMENT OF ANGLES AND TAPERS: Different methods – Bevel protractor – angle gauges – spirit levels – sine bar – Sine plate, rollers and spheres used to determine the tapers.

FLATNESS MEASUREMENT: Measurement of flatness of surfaces – straight edges– surface plates – optical flat and auto collimators, interferometer and their uses.

Learning outcome & Suggested Student Activities:

After completion of this unit students are able to study the different types of Comparators, optical measuring instruments, flatness measurement methods and measuring methods of surface roughness. <http://www.nptel.iitm.ac.in/and> for notes, <http://www.learnerstv.com/Free-Engineering-Video-lectures-Itv113-Page1.htm>

UNIT III

SURFACE ROUGHNESS MEASUREMENT: Differences between surface roughness and surface waviness- Numerical assessment of surface finish – CLA, R.M.S Values – R_a , R_z values, Methods of measurement of surface finish-profilograph, Talysurf, BIS symbols for indication of surface finish.

SCREW THREAD MEASUREMENT: Elements of measurement – errors in screw threads – measurement of effective diameter, angle of thread and thread pitch- profile thread gauges.

GEAR MEASUREMENT: Gear measuring instruments, Gear tooth profile measurement. Measurement of diameter, pitch, pressure angle and tooth thickness.

MACHINE TOOL ALIGNMENT TESTS: Requirements of Machine Tool Alignment Tests, Alignment tests on lathe, milling and drilling machine tools. Preparation of acceptance charts.

Learning outcome & Suggested Student Activities:

After completion of this unit students are able to understand, Screw thread elements and measuring methods, Gear tooth profile measurement, CMM, Alignment tests on lathe, milling and drilling machine tools.

UNIT IV

MEASUREMENT OF DISPLACEMENT: Theory and construction of various transducers to measure displacement - Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers, Calibration procedures.

MEASUREMENT OF SPEED: Mechanical Tachometers - Electrical tachometers - Stroboscope, Noncontact type of tachometer

STRESS & STRAIN MEASUREMENTS: Various types - electrical strain gauge - gauge factor - method of usage of resistance strain gauge for bending, compressive and tensile strains - usage for measuring torque, Strain gauge Rosettes.

MEASUREMENT OF ACCELERATION AND VIBRATION: Different simple instruments - Principles of Seismic instruments - Vibrometer and accelerometer.

Learning outcome & Suggested Student Activities:

After completion of this unit students are able to understand working of various instruments used for measuring for displacement, temperature and pressure.

UNIT V

MEASUREMENT OF TEMPERATURE: Standards and calibration, thermal expansion methods, thermo electric sensors(thermocouples), Electrical Resistance sensors, Junction semiconductor sensors, Digital thermometers, Radiation methods.

MEASUREMENT OF PRESSURE AND SOUND: Standards and calibration, basic methods of pressure measurement, dead weight gauges and manometers, Elastic transducers, vibrating cylinder, resonant transducers, High and low pressure measurement, sound measurement.

MEASUREMENT OF FORCE, TORQUE,POWER: Standards and calibration, Basic methods of Force Measurement, Torque measurement on rotating shafts, shaft power measurement(dynamometers), Vibrating wire force transducers.

Learning outcome & Suggested Student Activities:

After completion of this unit students are able to understand working of various instruments used for measuring for flow, speed, stress, strain and Vibration.

Text Books:

- (1) *Mechanical Measurements*, Beckwith, Marangoni, Linehard, PHI, PE
- (2) *Measurement systems: Application and design*, Doebelin Earnest. O. Adaptation by Manik and Dhanesh, TMH, 2012.
- (3) *Engineering Metrology*, R.K. Jain, Khanna Publishers, 20th edition, 2013.

Reference Books:

- (1) *Engineering Metrology*, Mahajan, DhanpatRai, 2nd edition, 2013.
- (2) *BIS standards on Limits & Fits*
- (3) *Fundamentals of Dimensional Metrology*, Connie Dn, CENGAGE LEARNERS
- (4) *Metrology & Measurement* by Anand K Bewoor, vinay A kulkarni, Mc GrawHill, 2013.
- (5) *Instrumentation, measurement & analysis*, B.C.Nakra&KKChoudhary, TMH, 6th edition, 2011.

Web References:

<http://emtool box.nist.gov>
CambridgeViscosity.com/Viscometer
www.e.FlukaCal.com/Calibration
www.inscotemperature.com/
www.solartronmetrology.com/

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**15A03704 REFRIGERATION AND AIR CONDITIONING
(CBCS- II)**
Course Objective:

This subject provides insights in how thermodynamic principles are applied within the refrigeration and air conditioning industry. It gives details on how different components work and influence each other. Students will learn how real systems used in commercial , industrial refrigeration and air conditioning industries are built-up.

The objective this subject is to make the student to have complete knowledge on various refrigeration methods like VCR, VAR and latest developments, knowledge on various air conditioning methods like summer, winter and year round air conditioning and to make the student to understand the practical applications of refrigeration and air conditioning systems.

UNIT I

Introduction to Refrigeration: Necessity and Applications, Carnot Refrigerator, First and Second Law Applied to Refrigerating Machines, Unit of Refrigeration, COP, EER, Different Refrigeration Methods

Air Refrigeration: Bell-Coleman Cycle, Ideal and Actual Cycles, Open and Dense Air Systems -Numerical Problems – Refrigeration Needs of Air Crafts.

Learning Outcome & Suggested Student Activities:

At the end of the chapter, student can able to understand the terminologies associated with refrigeration and also understand the basic principles of Refrigeration and applications. Student can also know the aspects of various natural refrigeration methods; understand the components of Air refrigeration system and the necessity of air craft refrigeration.

The following URLs are very useful to the students

<http://nptel.iitm.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Ref%20and%20Air%20Cond/pdf/RAC%20%20Lecture%201.pdf>

<http://www.ignou.ac.in/upload/Unit%201-32.pdf>

<http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Ref%20and%20Air%20Cond/pdf/RAC%20Lecture%209.pdf>

UNIT II

Vapour Compression Refrigeration (VCR) System – Basic Cycle - Working Principle and Essential Components of The Plant – COP – Representation of Cycle On T-S and P-h Charts – Expander Vs. Throttling, Effect of Sub Cooling and Super Heating – Cycle

Analysis – Actual Cycle- Influence of Various Parameters on System Performance – Construction and Use of P-h Charts – Numerical Problems.

Refrigerants – Desirable Properties – Classification of Refrigerants Used – Nomenclature- Secondary Refrigerants- Lubricants – Ozone Depletion – Global Warming- Newer Refrigerants.

Learning Outcome & Suggested Student Activities:

After the completion of the chapter, student can know the purpose and function of each of the components in the domestic refrigerator, analyzing the concepts of sub-cooling and super heating to improve the COP and also necessity of replacements for CFCs and HCFCs with new refrigerants. Following URLs are highly useful to the students

http://www.nptel.iitm.ac.in/courses/IITMADRAS/Applied_Thermodynamics/Module_6/6_Simple_Vapor_Compression_RS.pdf

http://www.mcquay.com/mcquaybiz/literature/lit_ch_wc/AppGuide/AG31-007.pdf

UNIT III

Vapor Absorption Refrigeration (VAR) System – Description and Working of NH₃ – Water System and Li Br –Water (Two Shell & Four Shell) System -Calculation of Max COP, Principle of Operation of Three Fluid Absorption System.

Steam Jet Refrigeration System: Working Principle and Basic Components-Estimation of Motive Steam Required, Principle and Operation of: (I) Thermo-Electric Refrigerator (II) Vortex Tube OrHilsch Tube.

Learning Outcome & Suggested Student Activities:

After the completion of the chapter, student can know the purpose and function of each of the basic components of the absorption refrigeration system. Student can have knowledge on latest developments of Electrolux, thermo electric vortex tube methods. Following URLs are highly useful to the students

<http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Ref%20and%20Air%20Cond/pdf/RAC%20Lecture%2014.pdf>

http://en.wikipedia.org/wiki/Thermoelectric_cooling

UNIT IV

Introduction to Air Conditioning: Psychrometric Properties & Processes – Characterization of Sensible and Latent Heat Loads — Need For Ventilation, Consideration of Infiltrated Air – Heat Load Concepts.

Air Conditioning Systems: Air Cooler (Evaporative Cooling) ,Window, Split, Summer , Winter, Year Round, Central Air Conditioning Systems.

Learning Outcome & Suggested Student Activities:

After the end of the chapter, student can have knowledge on the use of psychrometric terms in Air conditioning. Student can learn the use of psychrometric chart to know psychrometric properties of air. Student can able to understand the terms sensible heat load and latent heat load. This technical information is fundamental to all types of

domestic, commercial and industrial systems for the calculations of heat loads. Student is advised to conduct experiment on A.C tutor in the laboratory. Following URLs are highly useful to the students

<http://server.fst.uga.edu/kerr/FDST%204060/pdf%20files/7%20Psychrometrics.pdf>
<http://people.eng.unimelb.edu.au/mjbrear/436-432/chapter%208%20-%20psychrometry.pdf>
<http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Ref%20and%20Air%20Cond/pdf/R&AC%20Lecture%2031.pdf>

UNIT V

Air Conditioning Equipment - Humidifiers – Dehumidifiers – Air Filters, Fans and Blowers.

Human Comfort: Requirements of Temperature, Humidity And Concept of Effective Temperature, Comfort Chart.Heat Pump – Heat Sources – Different Heat Pump Circuits.

Learning Outcome & Suggested Student Activities:

After the completion of the chapter, student can understand the components of A/C system and describe the cooling equipment combinations. Student can describe the concept of human comfort chart and the processes by which the body produces and rejects heat. Student can be familiar with the Heat pump circuit analysis. Following URLs are highly useful to the students

Effective temp- <http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Ref%20and%20Air%20Cond/pdf/R&AC%20Lecture%2029.pdf>

http://courses.washington.edu/me333afe/Comfort_Health.pdf

<http://web.me.unr.edu/me372/Spring2001/Heat%20Pumps.pdf>

Text Books:

1. Refrigeration and Air Conditioning ,CP Arora,TMH, 15th edition, 2013.
2. A Course in Refrigeration and Air conditioning,S.CArora&Domkundwar, Dhanpatrai

Reference Books:

1. Refrigeration and Air Conditioning / Manohar Prasad / New Age, 2nd edition, 2013
2. Principles of Refrigeration - Dossat / Pearson Education, 4th edition, 2007.
3. Refrigeration and Air Conditioning-P.L.Ballaney, 2nd edition, 2012.
4. Basic Refrigeration and Air-Conditioning – P.N.Ananthanarayanan / TMH, 4th edition, 2013.

NOTE: Tables/Codes: Thermal Engineering Data Book containing Réfrigérant and Psychrometric property Tables and charts are permitted in Exam

Suggestions:

The entire syllabus is covered in the text book – “ A Course in Refrigeration and Air conditioning “ by Domkundwar, Arora, Dhanpatrai Publications (Highly useful book for GATE exam and other Government /Private sector competitive examinations)

Students can visit the nearby small scale Industries like Ice Plants to understand the principles of production of Ice and to observe the other simple components for practical understanding. Student is also advised to visit domestic refrigerator manufacturing industries/ Centralized and Split A/C system units.

Students are advised to watch the video lectures in the website - <http://nptel.iitm.ac.in>
The fundamental concepts of Thermodynamics, Psychrometrics etc., are required for better understanding of this subject.

Web Resources:

<http://www.refrigerationbasics.com/index.htm> <http://www.howstuffworks.com/ac.htm>

<http://www.ashrae.org>

<http://www.taftan.com/thermodynamics/AIRCOND.HTM>

<http://www.wisegeek.com/how-does-air-conditioning-work.htm>

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**15A03705 TOOL DESIGN
(CBC- II)**

Course Objective:

To make the students to understand the design of single point cutting tool.

To learn about the design of drilling tool, tool wear Machinability index and tool life.

To make the students to understand jigs and fixtures, design principle of jigs and fixtures, locating and clamping principles.

To learn about the sheet metal operations, Design forming ,drawings ,Bending and drawing dies, forming dies.

To make the students to understand plastics commonly used as tooling material.

UNIT I

Tool materials: Ferrous, non ferrous, materials, heat treatment, plastics Classification of moulds used in processing of plastics, Design of injection, blow, and compression moulds.

Learning outcome & Suggested Student Activities:

After completion of this unit, students are able to understand the fundamentals of plastics as tooling materials, processing of plastics for tooling materials, heat treatment of materials, ferrous, nonferrous, non metallic, tooling materials.

UNIT II

Design of single point cutting tools: Single point, cutting tools-various systems of specifications, geometry and their interrelation, theories of formation of chip and their effect.

Learning outcome & Suggested Student Activities:

After completion of this unit students are able to understand single point cutting tool geometry and its design theory of chip formation.

UNIT III

Design of multipoint cutting tools: Drill geometry, Design of Drills, Rake & Relief angles of twist drill, speed, feed and depth of cut, machining time, forces, milling cutters, cutting speeds and feed-machining times-design-form cutters, combination tools, reamers etc.

Learning outcome & Suggested Student Activities:

After completion of this unit students are able to understand the drilling tool geometry and its design. Tool life, machinability and tool wear.

UNIT IV

Design of jigs and fixtures: Basic principles of location and clamping, locating, methods and devices, jigs, definitions, types, general consideration in the design of jigs, drills bushing, methods of construction, fixtures-vice fixtures milling, boring, and lathe grinding fixtures.

Learning outcome &Suggested Student Activities:

After completion of this unit students are able to understand the design of Jigs and fixtures and advantages and disadvantages of Jigs and fixtures, types of Jigs & Fixtures – Principles of location and clamping. Some examples of jigs and fixtures.

UNIT V

Design of sheet metal blanking and piercing: Fundamentals of die cutting operating, power press- types, General press information, Material handling equipment, cutting action in punch and die operation. Die clearance, and types of Die construction. Die design fundamentals-blanking and piercing die construction, pilots, stripper and pressure pads presswork material, strip layout.

Design of sheet metal bending, forming and drawings die: Bending dies, drawing dies, forming dies, drawing operations, variables that effect metal flow during drawing. Determination of blank size, drawing force, single and double action draw dies.

Learning outcome &Suggested Student Activities:

After completion of this unit students are able to understand the press working operations like punching, blanking, bending, drawing and forming, types of power presses, design of die, strip layout

Text Books:

1. *Tool Design, Donaldson, Lecain and Goold, Tata McGraw Hill, 4th edition, 2012.*
2. *Principles of Metal cutting, A Bhattacharya, New Central Book Agency, Calcutta*
3. *ASTME Hand book on Tool Design.*

Reference Books:

1. *Production Engineering Design (Tool Design) , SurendraKenav and Umesh 'Chandra, Satyaprakashan, New Delhi 1994..*
2. *Design of cutting Tools. Use of Metal Cutting Theory. ASTME publication Michigan USA, 1969.Amitabha Battacharya*

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**15A03706 MODERN MANUFACTURING METHODS
(CBCC- II)**

UNIT I

Need for Modern Manufacturing Methods: Non-traditional machining methods and rapid prototyping

methods - their relevance for precision and lean manufacturing.

Classification of non-traditional processes - their selection for processing of different materials and the range of applications.

Introduction to rapid prototyping - Classification of rapid prototyping methods - stereolithography, fused deposition methods - materials, principle of prototyping and various applications.

UNIT II

Ultrasonic machining – Elements of the process, mechanics of material removal, process parameters, applications and limitations.

Abrasive jet, Water jet and abrasive water jet machining: Basic mechanics of material removal, descriptive of equipment, process variables, applications and limitations.

UNIT III

Electro – Chemical Processes: Fundamentals of electro chemical machining, electrochemical grinding, metal removal rate in ECM, Tooling, process variables, applications, economic aspects of ECM.

Chemical Machining: Fundamentals of chemical machining- Principle of material removal- maskants – etchants- process variables, advantages and applications.

UNIT IV

Thermal Metal Removal Processes: Basic principle of spark erosion (EDM), Wire cut EDM, and Electric Discharge Grinding processes - Mechanics of machining, process parameters, selection of tool electrode and dielectric fluids, choice of parameters for improved surface finish and machining accuracy -

Applications of different processes and their limitations.

Plasma Machining: Principle of material removal, description of process and equipment, process

variables, scope of applications and the process limitations.

UNIT V

Electron Beam Machining: Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non-thermal processes - process mechanics, parameters, applications and limitations. Laser Beam Machining: Process description, Mechanism of material removal, process parameters, capabilities and limitations, features of machining, applications and limitations.

Text Books:

1. *Advanced machining processes*, VK Jain, Allied publishers.
2. *Manufacturing processes for engineering materials* by Serope Kalpakjian and Steven R Schmid, 5edn, Pearson Pub.

Reference Books:

1. *New Technology*, Bhattacharya A, The Institution of Engineers, India 1984
2. *Manufacturing Technology*, Kalpakzian, Pearson
3. *Modern Machining Process*, Pandey P.C. and Shah H.S., TMH.

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**15A03707 COMPUTATIONAL FLUID DYNAMICS
(CBCS- III)**
Course Objective:

This course covers topics related to Computational Fluid Dynamics (CFD). CFD is an important tool in engineering analysis and design of fluid systems. In this course Students will develop the equations describing fluid flow and numerical solutions to these equations. Emphasis will be placed on understanding different approaches employed for both time and spatial discretization and how to evaluate these approaches. Students will look at time accurate and steady-state methods, explicit and implicit techniques, laminar and turbulent flow, compressible and incompressible approaches, stability considerations, etc. These techniques will be applied to applications of mixing and heat transfer.

UNIT I

INTRODUCTION: Methods to solve a physical problem , numerical methods , brief comparison between FDM, FEM & FVM, applied numerical methods. Solution of a system of simultaneous linear algebraic equations, Iterative schemes of matrix inversion, direct methods for matrix inversion, direct methods for banded matrices. Finite difference applications in heat conduction and convection, heat conduction, steady heat conduction in a rectangular geometry, transient heat conduction, finite difference application in convective heat transfer.

Learning outcome & Suggested Student Activities:

This chapter gives the overall view of the various kinds of numerical methods adopted. It also discusses about various solutions for the numerical methods adopted in CFD. The applications of finite difference methods with examples in conduction and convective heat transfer are introduced.

UNIT II

FINITE DIFFERENCES: Discretization, consistency, stability, and fundamentals of fluid flow modeling. Introduction, elementary finite difference quotients, implementation aspects of finite-difference equations, consistency, explicit and implicit methods.

Learning outcome & Suggested Student Activities:

This chapter gives how to discretize partial differential equations, including the governing flow equations which is the foundation for the finite difference method. Explicit and implicit approaches represent the fundamental distinction between various numerical techniques.

UNIT III

ERRORS AND STABILITY ANALYSIS: introduction, first order wave equation, stability of hyperbolic and elliptic equations, fundamentals of fluid flow modeling, conservative property, the upwind scheme.

REVIEW OF EQUATIONS GOVERNING FLUID FLOW AND HEAT TRANSFER: Introduction, Conservation of mass Newton's second law of motion, expanded forms of Navier-stokes equations, conservation of energy principle, special forms of the Navier stokes equations.

Learning outcome & Suggested Student Activities:

This chapter focuses on numerical errors that are generated and how the numerical calculations become unstable and also entails the conservations of mass, momentum and energy equations to the fluid flow along with Navier stokes equation.

UNIT IV

STEADY FLOW: Dimensions form of momentum and energy equations, navier stokes equation, and conservative body force fields, stream function, vorticity formulation, boundary, layer theory, buoyancy, driven convection and stability.

Learning outcome & Suggested Student Activities:

This unit gives the fundamental principles of fluid mechanics, its governing differential equations and boundary conditions.

UNIT V

SIMPLE CFD TECHNIQUES: Viscous flows conservation form space marching, relocation techniques, viscous flows, conservation from space marching relocation techniques, artificial viscosity, the alternating direction implicit techniques, pressure correction technique, computer graphic techniques used in CFD. Quasi one dimensional flow through a nozzle, turbulence models, standard and high reynolds number models and their applications.

Learning outcome & Suggested Student Activities:

This unit gives the information about some techniques for numerical solutions for flow problems. These equations are applicable to time and space marching solutions especially parabolic hyperbolic and elliptic equations.

Text Books:

1. *Computational Fluid Dynamics, J Chung (2010), 2nd edition, Cambridge University Press, India.*
2. *Computational Fluid Dynamics, John .D. Anderson (2010), 3rd edition, McGraw- Hill International Edition, India.*

Reference Books:

1. *Computational Fluid Mechanics and Heat Transfer*, Ronnie Anderson, 3rd edition, CRC Press, Special Indian Edition.
2. *Computational aerodynamics and fluid dynamics an introduction*, Jean-Jacques Chattot (2010), 3rd edition, Springer, Germany.
3. *Essential computational fluid Dynamics* – olegzikanov, wiley India.
4. *Introduction to computational fluid dynamics* – pradip, Niyogi S.K. Chakrabary, M.K. Laha – pearson.

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**15A03708 AUTOMATION AND ROBOTICS
(CBCC- III)**

Course Objective:

The subject should enable the students to understand the principles of automation, importance of automated flow lines and its types.

To learn the concepts of Robotics, kinematics of robot, principles of robot drives and controls, sensors used in robots and programming methods.

UNIT I

Introduction to Automation: Need, Types, Basic elements of an automated system, Manufacturing Industries, Types of production, Functions in manufacturing, Organization and information processing in manufacturing, Automation strategies and levels of automation.

Hardware components for automation and process control, mechanical feeders, hoppers, orienters, high speed automatic insertion devices.

Learning outcome & Suggested Student Activities:

After completion of this unit students are able to understand to know what is automation, types of automation, components of automation, strategies and levels of automation. Student is advised to visit URLs <http://www.nptel.iitm.ac.in/and iitb.ac.in> , <http://www.learnerstv.com/video/Free-video-Lecture-30103-Engineering.htm> for video lectures.

UNIT II

Automated flow lines: Part transfer methods and mechanisms, types of Flow lines, flow line with/without buffer storage.

Assembly line balancing: Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

Learning outcome & Suggested Student Activities:

After completion of this unit students are able to understand the types of flow lines, quantitative analysis of flow lines, how the assembly is carried out on automated flow line without interruption and how to balance the line and flexible assembly lines.

Student is advised to visit URLs

<http://www.nptel.iitm.ac.in/and iitb.ac.in>,

<http://www.learnerstv.com/video/Free-video-Lecture-30103-Engineering.htm> for video lectures.

UNIT III

Introduction to Industrial Robotics: Classification of Robot Configurations, functional line diagram, degrees of freedom. Components common types of arms, joints grippers, factors to be considered in the design of grippers.

Robot Application in Manufacturing: Material Transfer - Material handling, loading and unloading - Process - spot and continuous arc welding & spray painting - Assembly and Inspection.

Learning outcome & Suggested Student Activities:

Student should come to know the various components in the anatomy of robot. By knowing this the student may apply in the design of new robotic structure. Student is advised to visit URLs

<http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv071-Page1.htm>

UNIT IV

Manipulator Kinematics: Homogenous transformations as applicable to rotation and transition - D-H notation, Forward inverse kinematics.

Robot actuators and Feedback components: Actuators, Pneumatic, Hydraulic actuators, Electric & Stepper motors, comparison. Position sensors - potentiometers, resolvers, encoders - velocity sensors, Tactile sensors, Proximity sensors.

Learning outcome & Suggested Student Activities:

After completion of this unit students are able to understand the applications of various types of end effectors, and sensor devices. Student should also learn about the homogeneous transformations and its applications in the analysis of a robotic structure and method of developing different types of mechanisms and kinematics of the robot. Student is advised to visit URLs

<http://www.nptel.iitm.ac.in> , <http://www.iitb.ac.in> , <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv071-Page1.htm>

UNIT V

Manipulator Dynamics: Differential transformations, Jacobians, Lagrange - Euler and Newton - Euler formations. Trajectory Planning: Trajectory Planning and avoidance of obstacles path planning, skew motion, joint integrated motion - straight line motion.

Learning outcome & Suggested Student Activities:

After completion of this unit students are able to understand robot programming languages which may adopt in different applications of robot. Student also knows the control motion mechanism in all devices of robot and application of robots in manufacturing sector. Student is advised to visit URLs

<http://www.nptel.iitm.ac.in/and> <http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv071-Page1.htm>

Text Books:

1. *Automation , Production systems and CIM*,M.P. Groover/Pearson Edu.
2. *Industrial Robotics - M.P. Groover, TMH.*

Reference Books:

1. *Robotics , Fu K S, McGraw Hill, 4th edition, 2010.*
2. *An Introduction to Robot Technology, P. Coiffet and M. Chaironze, Kogam Page Ltd. 1983 London.*
3. *Robotic Engineering , Richard D. Klafter, Prentice Hall*
4. *Robotics, Fundamental Concepts and analysis – AshitaveGhosal,Oxford Press, 1/e, 2006*
5. *Robotics and Control , Mittal R K &Nagrath I J , TMH.*
6. *Introduction to Robotics – John J. Craig,PearsonEdu*

Web References:

http://www.cadcamfunda.com/cam_computer_aided_manufacturing
<http://wings.buffalo.edu/eng/mae/courses/460-564/Course-Notes/cnc-classnotes.pdf>
<http://nptel.iitm.ac.in/courses.php?branch=Mechanical>
<http://academicearth.org/courses/introduction-to-roboticsVideo>
references:-<http://nptel.iitm.ac.in/video.php?courseId=1052>

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**15A03709 PRODUCTION AND OPERATIONS MANAGEMENT
(CBCC- III)**

Course Objective:

To make the students understand the functions of production planning & controls, generating of new products, issues in product design and strategies of aggregate planning. To provide the knowledge on principles of forecasting, forecasting methods, types and its accuracy. To provide the knowledge on facilities location, various types layouts and assembly line balancing. To provide the knowledge on lean management, concepts of JIT, six sigma, quality control, MRP,ERP and LOB. To make the students understand the inventory management and scheduling techniques.

UNIT I

Functions of Production Planning & Controls operations & productivity, productivity measurement, Design of goods and services: selection, generating new products, product development, issues in product design. Strategies for aggregates planning, aggregate planning using O.R. Models, Chase planning, Expediting, controlling aspects.

Learning Outcome & Suggested Student Activities:

At the end of this unit students can get the concepts on Production planning & controls operations and its functions, productivity and productivity measurements, design of goods and services and aggregate planning. Students are advised to visit following URLs
http://www.nptel.iitm.ac.in/courses/IIT-MADRAS/Management_Science_II/Pdf/3_5.pdf. And also well documented note is available in pdf form at the following links.
www.processprotocol.com/extranet/documents/pdf/.../production1.pdf
elearning.dbhosting.net/.../Production%20Planning%20And%20Control
<http://www.academicearth.org/lectures/product-development-process-observation>

UNIT II

Forecasting – Importance of forecasting – Types of forecasting, their uses – General Principles of forecasting – Forecasting techniques – qualitative methods and quantitative methods – accuracy of forecasting methods. Scheduling Policies – Techniques, flow shop and job shop Scheduling techniques.

Learning Outcome & Suggested Student Activities:

Students can understand the importance of forecasting, uses of long term and short term forecasting and application of qualitative and quantitative methods for finding the future demands. Students are advised to refer the text book Forecasting: Methods and Applications Spyros G. Makridakis, Steven C. Wheelwright, Rob J Hyndman. For video lectures advised to visit following URLs <http://www.learnerstv.com/video/Free-video-Lecture-2496-Management.htm>; http://www.slideshare.net/jrdn_27/qualitative-and-quantitative-methods-of-research

UNIT III

Factors affecting facilities location, mathematical models for facilities, location, Types of facilities- layout: product layout, process layout, group technology layout, Assembly line balancing, computerized layout: ALDEP, CRAFT, CORELAP.

Learning Outcome & Suggested Student Activities:

At the end of the unit the student will be able to understand where the plant is to be located based on facilities available and what are the important factors affecting the facilities location of a plant, and plant layout. And also able to understand plant layout design to facilitate material flow and processing of a product in the most efficient manner through the shortest possible time. Can compare the rural & urban sites, methods of selection. The following URLs are useful to the students
<http://www.slideshare.net/satya4/plant-layout-16143741>
<http://freevideolectures.com/Course/2371/Project-and-Production-Management/32>
<http://www.tcyonline.com/video-tutorials-computerised-layout-planning/101568>

UNIT IV

Lean Management, philosophy and creation of lean enterprise, JIT concepts-Kanban System-Elements of total quality management, Six Sigma Quality Control. MRP, –lot sizing techniques in MRP, introduction to ERP, LOB (Line of Balance).

Learning Outcome & Suggested Student Activities:

Students can understand the how philosophy of lean management applied to develop lean enterprise and basic concepts JIT, Six sigma control etc., Students are advised to visit the following URLs <http://www.learnerstv.com/video/Free-video-Lecture-6944-Management.htm>; <http://ocw.mit.edu/courses/aeronautics-and-astronautics/16-852j-integrating-the-lean-enterprise-fall-2005/lecture-notes/>
<http://freevideolectures.com/Course/2688/Human-Resource-Management/13>

UNIT V

Inventory management – Functions of inventories – relevant inventory costs – ABC analysis – VED analysis – EOQ model – Inventory control systems – various models Simple Problems.

Learning Outcome & Suggested Student Activities:

At the end of the unit the student will be able to understand the scheduling policies, flow shop and job shop scheduling techniques and concepts of Inventory, Classification, Functions, it's associated costs etc., and also able to recognize the importance of Inventory control to ensure their availability with minimum capital lock up. The following URLs are useful to the students.

<http://www.technologyevaluation.com/search/for/inventory-management-pdf.html>

<http://freevideolectures.com/Course/3096/Operations-and-Supply-Chain-Management/10>

Text Books:

1. *Production and Operations Management*, Ajay K Garg, McGrawHill, 2015
2. *Operation Management* by B. Mahadevan, PearsonEdu.
3. *Operation and O.M* by Adam & Ebert- PHI Pub.,

Reference Books:

1. *Operations Management* – S.N. Chary.
2. *Modern Production , Operations Management ,* Baffa&Rakesh Sarin.
3. *Production Control A Quantitative Approach ,* John E. Biegel.
4. *Production Control ,* Moore.
5. *Operations Management ,* Joseph Monks.
6. *Operation Management* by Jay Heizar& Read new Pearson
7. *Elements of Production Planning and Control,* Samuel Eilon.

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15A03710 CAD/CAM LABORATORY

LIST OF EXPERIMENTS:

- I. 2D Drafting using Auto CAD or any drafting package
- II. 3D Modeling :
 - 1. Modeling of Component in 3D – V block
 - 2. Modeling of Component in 3D – Open Bearing
 - 3. Modeling of Component in 3D – Angular block
 - 4. Modeling of Component in 3D – Dovetail Guide
 - 5. Modeling of Component in 3D – Dovetail Bracket
 - 6. Modeling of Component in 3D – Tool post

Geometric Modeling may be done Using Auto CAD or Pro-E or CATIA or Solid Works or Iron CAD

III. Assembly Modeling:

- 1. Assembly of a screw jack parts
- 2. Assembly of a knuckle joint
- 3. Assembly of a Oldham's coupling
- 4. Assembly of a footstep bearing
- 5. Assembly of a stuffing box
- 6. Assembly of a square tool post

IV. Machining of Simple Components on CNC Lathe and CNC Milling Machine.

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15A03711 METROLOGY & MEASUREMENTS LABORATORY

Any 6 experiments from each section

Section A:

1. Measurement of bores by internal micrometers and dial bore indicators.
2. Use of gear teeth vernier calipers and checking the chordal addendum and chordal height of spur gear.
3. Alignment test on the lathe and milling machine
4. Study of Tool makers microscope and its application
5. Angle and taper measurements by Bevel protractor, Sine bars, spirit level etc.
6. Thread measurement by Two wire/ Three wire method.
7. Surface roughness measurement by Talysurf instrument.
8. Use of straight edge and spirit level in finding the flatness of surface plate.

Section B:

1. Calibration of Pressure Gauges
2. Calibration of transducer or thermocouple for temperature measurement.
3. Study and calibration of LVDT transducer for displacement measurement.
4. Study and calibration of capacitive transducer for angular measurement.
5. Study and calibration of photo and magnetic speed pickups for the measurement of speed.
6. Study and calibration of a rotometer for flow measurement.
7. Study and use of a Seismic pickup for the measurement of vibration amplitude of an engine bed at various loads.
8. Study and calibration of McLeod gauge for low pressure.